Advanced Composite Thrust Chambers for the Altair Lunar Lander, Phase I

Completed Technology Project (2009 - 2009)

Project Introduction

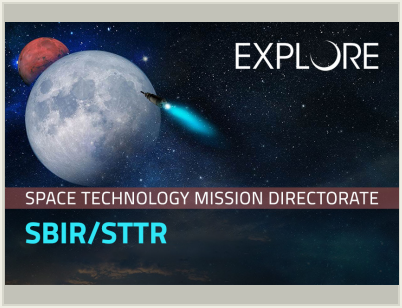
Radiation-cooled, bipropellant thrusters are being considered for the Ascent Module main engine of the Altair Lunar Lander. Currently, iridium-lined rhenium combustion chambers are the state-of-the-art for radiatively cooled thrusters. To increase the performance of radiation-cooled engines, improved chamber materials are being developed that will allow higher operating temperatures, better resistance to oxidation, and reduce mass. In an effort to increase performance, hafnium oxide thermal barrier coatings and improved iridium liners have been developed, and hot-fire tests of rhenium chambers with these improvements have shown higher operating temperatures, i.e., >200

o

C increase, are possible. To reduce engine mass, recent efforts have focused on the development of carbon-carbon composites. Replacement of a rhenium structural wall with carbon-carbon could result in a mass savings of >600%. During this effort, an innovative composite thrust chamber will be developed that will incorporate advanced hafnium oxide and iridium liner techniques as well as replacing the expensive, high density rhenium with a low mass carbon-carbon composite. As a result of this investigation, an advanced composite thrust chamber with improved performance capability and reduced mass will be produced. During Phase II, the fabrication methods will be optimized and a full-size Ascent Module chamber will be produced and hot-fire tested.

Anticipated Benefits

Potential NASA Commercial Applications: Both government and commercial entities in the following sectors use advanced high-temperature materials for the following applications: coatings, defense, material R&D, nuclear power, aerospace, propulsion, automotive, electronics, crystal growth, and medical. PPI's targeted commercial applications include net-shape fabrication of refractory and platinum group metals for rocket nozzles, crucibles, heat pipes, and propulsion subcomponents; and advanced coating systems for x-ray targets, sputtering targets, turbines, rocket engines, wear and thermal/electrical insulation.



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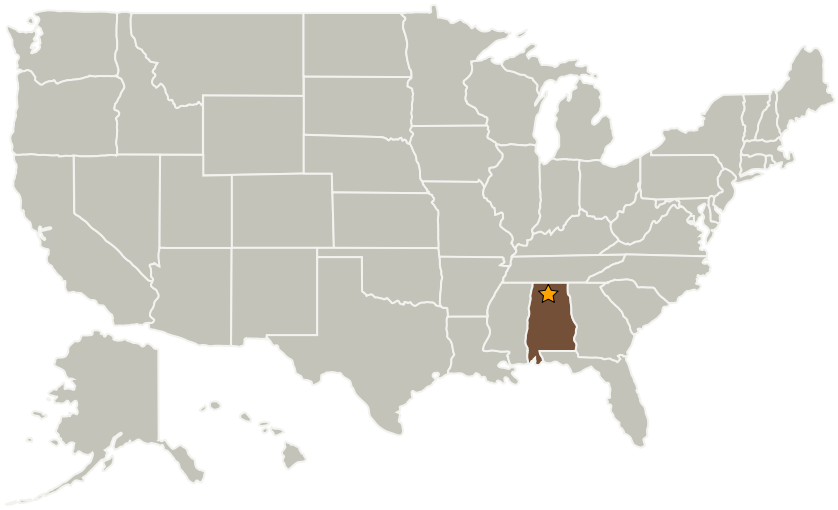
Completed Technology Project (2009 - 2009)

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Marshall Space Flight Center(MSFC)	Lead Organization	NASA Center	Huntsville, Alabama
Plasma Processes, LLC	Supporting Organization	Industry Veteran-Owned Small Business (VOSB)	Huntsville, Alabama

Primary U.S. Work Locations
Alabama

Project Transitions

January 2009: Project Start

July 2009: Closed out

Closeout Summary: Advanced Composite Thrust Chambers for the Altair Lunar Lander, Phase I Project Image

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Marshall Space Flight Center (MSFC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

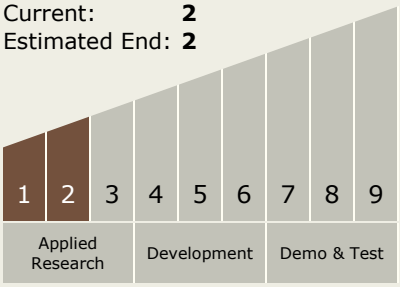
Carlos Torrez

Principal Investigator:

John Scott S O'dell

Technology Maturity (TRL)

Start: **1**
Current: **2**
Estimated End: **2**



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Completed Technology Project (2009 - 2009)

Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.1 Chemical Space Propulsion
    - TX01.1.3 Cryogenic